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06522700001

Patents ADP number *(if you know it)*

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4. Title of the invention

NETWORKS AND METHODS AND DEVICES THEREFOR

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Networks and methods and devices therefor

The present invention relates to networks, devices for use in networks and methods of operating the networks and devices therein.

The following description is illustrative of examples of the inventions and is not limitative of the inventions disclosed herein.

Summary

The network manager project explores novel solutions for data transport and routing systems in broadcast domain to be replaced by commodity IT network infrastructure.

Two main applications have been identified to support the network manager project:

- a network manager

  The configuration and operation of the network is done via the network manager. A single PC provides the functionality of the network manager.

- a video proxy-pre-selection suite

  The use of IP networks to transport AV data during the production process allows direct interface with other I.T. systems. Switching or editing decisions are usually made upon the content of video and/or audio.

The Human Factors (HF) involvement into the network project is two fold:

- to investigate the application requirements
- to design a switch control interface for the network manager system

1. Network project

The network manager project explores novel solutions for data transport and routing systems in broadcast domain to be replaced by commodity IT network infrastructure (i.e. a gigabit Ethernet switch and Cat 5 cables). The philosophy of the network project is:

- to use commodity IT infrastructure such as gigabit Ethernet switches.
- to employ open standards, such as Ethernet, IP, UDP, DHCP where possible
- to provide Sony technology to create value

The configuration and operation of the network is done via the network manager. The role of the interface is to allow all network manager operations to be carried out. There are three levels of operations (see Figure 1):

- the operation of the network
- the operation of the network manager itself
- the operation of video proxy pre-selection

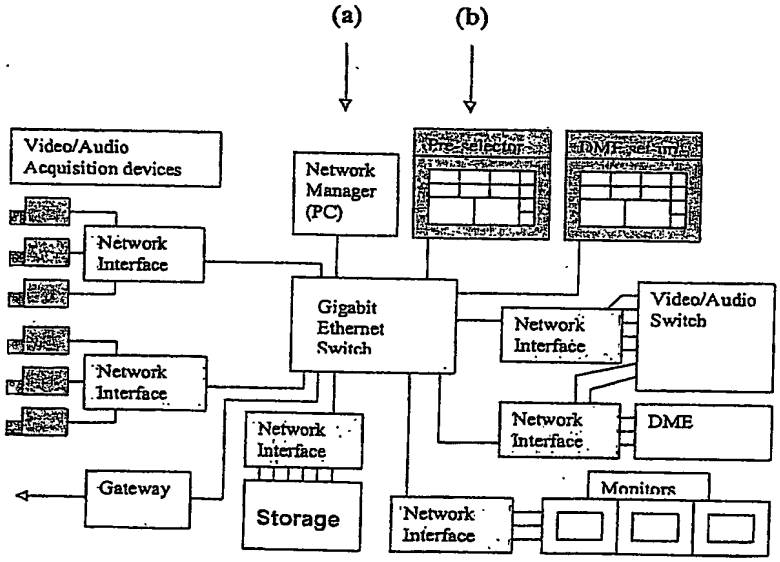


Figure 1 Example of Networked A/V system using Proxy Video streams for Pre-selection of Video switch inputs.

Two main applications are required to support the network manager project:

- a network manager (see Figure 1a)

  For the configuration and operation of the network.

- a video proxy-pre-selection suite (see Figure 1b)

  For switching or editing decisions.

The interface should comprise a number of 'views' of the network. A network engineer requires a 'lower level' view of the network than an operator who wishes to send the output of a camera to a monitor.

The following sections explain in more detail the concept of these applications.

1.1 Network manager

Current solutions for the interconnection of professional video equipment in a production environment use network connections and data protocols. The network manager project has demonstrated that data transport and routing systems can be replaced by commodity IT network infrastructure (i.e. a gigabit Ethernet switch and Cat 5 cables). A means of connecting equipment to the network has been developed, the enhanced network interface card (ENIC). ENIC is a card that allows the video data to be put together in a suiteable way for transport down a standard Ethernet cable. The card is then managed using a network manager system. A network manager system has also been developed that will be used to configure the switch and ENICs to ensure the system operates as desired.

The configuration and operation of the network is done via the network manager system, this involves:

- the addition of devices to the network
- establishing 'connections' between devices
- device configuration
    - initial device configuration
    - operational device configuration
- removing 'connections' between devices
- the monitoring of device status

The functionality of the network manager is provided by a single PC.

A preliminary interface provides a basic engineering approach to utilise some of the network manager functionality (see Figure 2). It presents a number of ENICs, each having 3 video sources (e.g. items of equipment such as cameras and VTRs in play mode) and 3 video destinations (e.g. items of equipment such as Monitors and VTRs in record mode).

Connections use IP multicast, a mechanism that facilitates data transfer from one source to multiple, specified destinations (e.g. one video playing in could be connected to three monitors, or three cameras could be connected to three videos). The interface reflects this by allowing multiple destinations to be connected to a single source. This is currently achieved by left mouse clicking the source first, followed by right clicking on the selected destinations, which is really clunky and difficult to read. Numbers are used to identify connections, on what looks like blocks on each ENIC. There are no lines illustrating connection between ENICs in the interface. It is possible to label the ENIC with an address (e.g. 1.1.111.1) so that the users can be aware of where and what it is.

This interface addresses only a small part of the application requirements. Section 2, outlines the application requirements that need to be addressed. While Section 3, provides initial design solutions that reflect the application requirements.

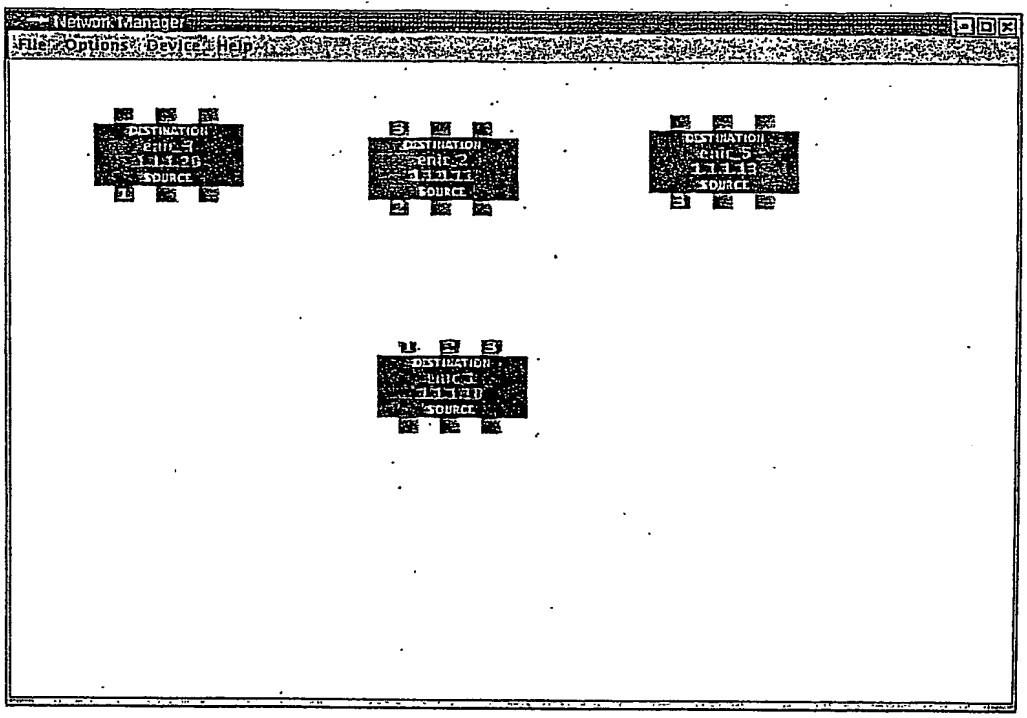


Figure 2 Digital Network manager functionality interface.

1.2 Video Proxy pre-selection

The use of IP networks to transport AV data during the production process allows direct interface with other I.T. systems. Switching or editing decisions are usually made upon the content of video and/or audio. A proposed solution is the generation of a lower quality video proxy of each stream.

One example of the use of such proxy video concerns the use of proxy video for pre-selection video sources for a live video switch.

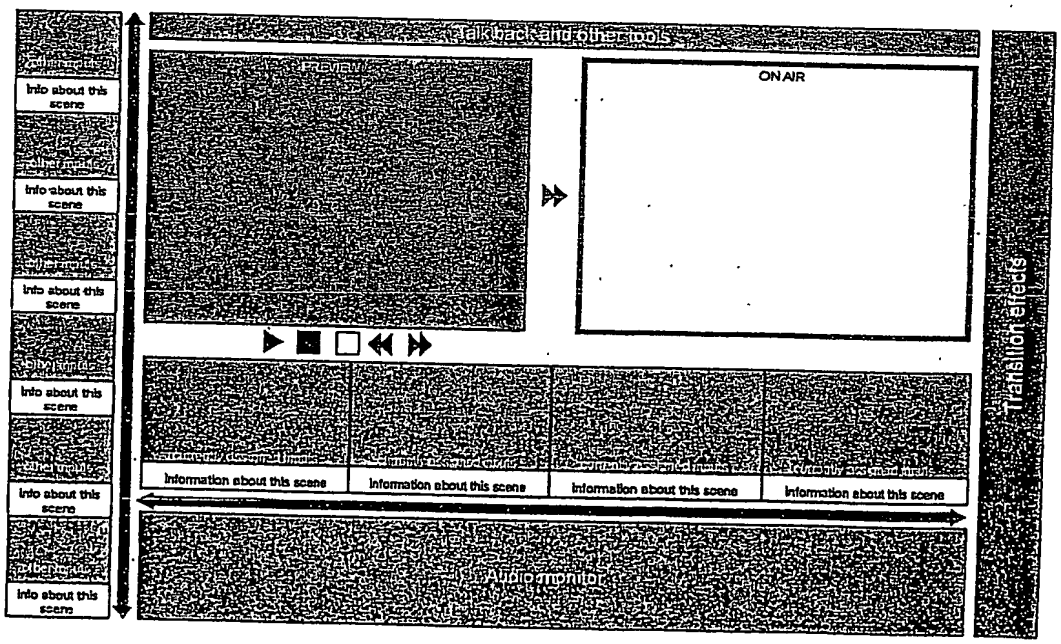
The video proxy pre-selection suite needs to reproduce the production suite. The application needs to support a mechanism for assigned inputs to the video switch, where

switching is based on reviewing the source content. Transition effects, camera control and talk back to the cameramen are issues that need to be considered.

Some basic forms of such a layout are shown in Figure 3.

Section 2, outlines in detail the video proxy pre-selection suite requirements. Section 3, provides initial design solutions that reflect the application requirements.

(a)



(b)

Figure 3 (a,b) Video proxy pre-selection interface concepts.

2. Requirements specification

This section outlines requirements specification for the network manager and the video proxy pre-selection suite. The requirements specification is based on HF collaboration with engineers and a survey of currently provided technology solutions. The current list of requirements is expected to be expanded based on broadcast industry professionals feedback. Additional requirements will be extracted from broadcast professionals through exposure to prototype design solutions based on the currently identified requirements specifications.

2.1 Network manager

The following requirements for the network manager application have been identified:

- display currently assigned inputs to the live video switch
- display other sources not currently assigned to the video switch
- display currently assigned controllers
- display currently assigned destinations to the live video switch
- provide a means for reviewing source content in low resolution
- provide a means for reviewing source content in high resolution
- provide an audio monitor to support the main audio channel, of any source
- display currently selected output of the video switch
- provide a way to create – modify a source pre-selection list
- provide a means for reviewing control group sources
- provide a means for reviewing source information - type, name, timecode, status (all source names should be reviewed, even the ones assigned by different groups)
- provide a means to configure source information (e.g. name)
- provide a way to control source (e.g. VTR - play, pause, rewind, camera - camera movement, zoom setting, zoom range, audio – play, pause, rewind)
- provide a mechanism for assigning source to a destination
- provide a mechanism for assigning assign source to a controller
- display currently selected source destinations
- display currently selected source controllers
- support pre-selection for setting up a DSP

3. Design solutions

This section suggests an initial approach to design solutions for the network manager application and the video proxy pre-selection suite. These design solutions address the projects requirements outlined in Section 2. Paper mock-ups of the network manager and an interactive prototype of the video proxy pre-selection suite provide a first exposure of the system to broadcast professionals. They also provide the basis for evaluation of the system requirements as well as the suggested design solutions.

3.1 Network manager

The network manager provides a solution for configuring and reviewing the network. The network manager functionality is provided by a single PC. This means that the network manager can be simultaneously available to different users providing different views and permissions according to different users' profile.

3.1.1 Network manager GUI components

The GUI for the network manager is designed for a 1024x768 display (see Figure 4).

The network manager GUI is divided in three main areas (see Figure 1):

1. the 'network management area'

   This area displays the source, the source controllers and source destination.

2. the 'source content review area'

   This area provides a means of reviewing the source content (in low or high resolution) and control the source.

3. the 'routing review area'

   This area provides more information about the actual routing of a device. However, more information is required regarding what exactly needs to be represented in trace routing.

The following sections expand on these components.

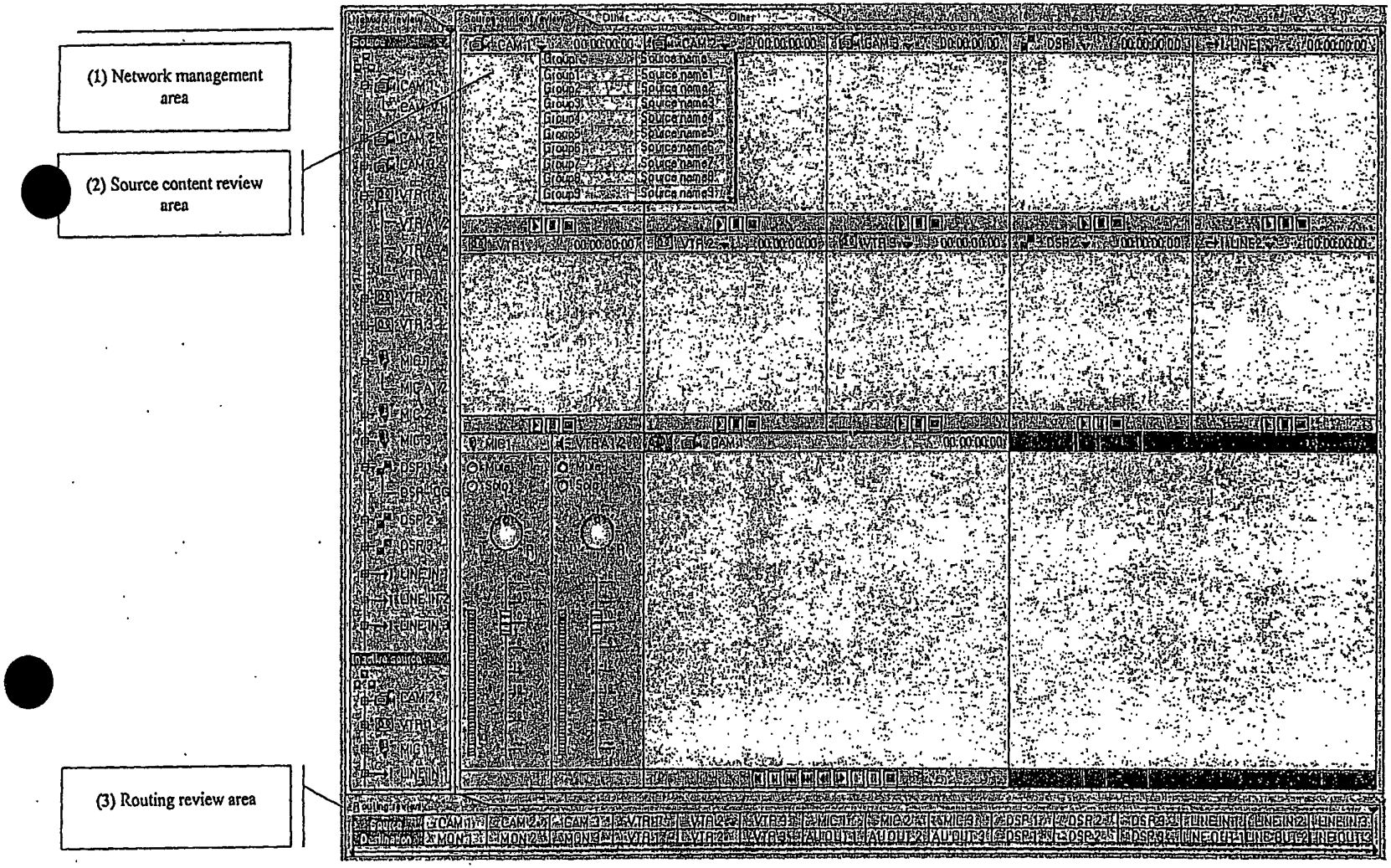


Figure 4 The video proxy pre-selection GUI for the network project

3.1.1.1 Network management area

The network management area serves for displaying the source, the source controllers and source destination, configure network devices and allow the connectivity of network devices.

The network management area should:

- display currently assigned inputs to the live video switch
- display other sources not currently assigned to the video switch
- display currently assigned controllers
- display a means for reviewing control group sources

  These could be either as QCIF Proxy video streams or even QQCIF streams or full resolution depending on the set-up of the receiving application.
- provide a means to configure source information (e.g. name)
- provide a mechanism for assigning source to a destination
- provide a mechanism for assigning assign source to a controller
- display currently selected source destinations
- display currently selected source controllers
- support pre-selection for setting up a DSP

The currently assigned input area should provide information about the:

- source type
  - camera
  - VTR
  - Microphone
  - digital signal processing (DSP)
  - line
- source names and control group sources
  - camera
    - CAM V1 – [sub-name]
  - VTR
    - VTR A1/2 – [sub-name]
    - VTR A3/4 – [sub-name]
    - VTR V1 – [sub-name]
  - Microphone

        - MIC A1/2 – [sub-name]
    - DSP
        - source name – control group sources – [sub-name] – DSP route function

The source and DSP relations should also be displayed (e.g. DSP source)

- linkage
    - true source
    - linked source

The currently assigned destination area should provide information about the:

- destination type
    - monitor
    - VTR
        - V1
    - Audio OUT
        - A1/2
    - DSP (this can also be a DSP to DME)
- destination name
- source's destination
    - full
        - VRT1-DSP
    - limited version of destination
        - VRT1

The currently assigned controller area should provide information about the:

- controller type
- controller name
- controller's location
    - external
    - local

Two version of the network management area are provides:

- a minimised version of the network management area (see Figure 4a)

  This displays the currently assigned inputs to the live video switch

- an expanded version of the network management area (see Figure 4b)

This displays the currently assigned inputs to the live video switch, the inputs control group sources, the controllers and the destinations that these are assigned to. It also provides information related to the link between input devices and DSPs.

It also provides a way of changing the source information.

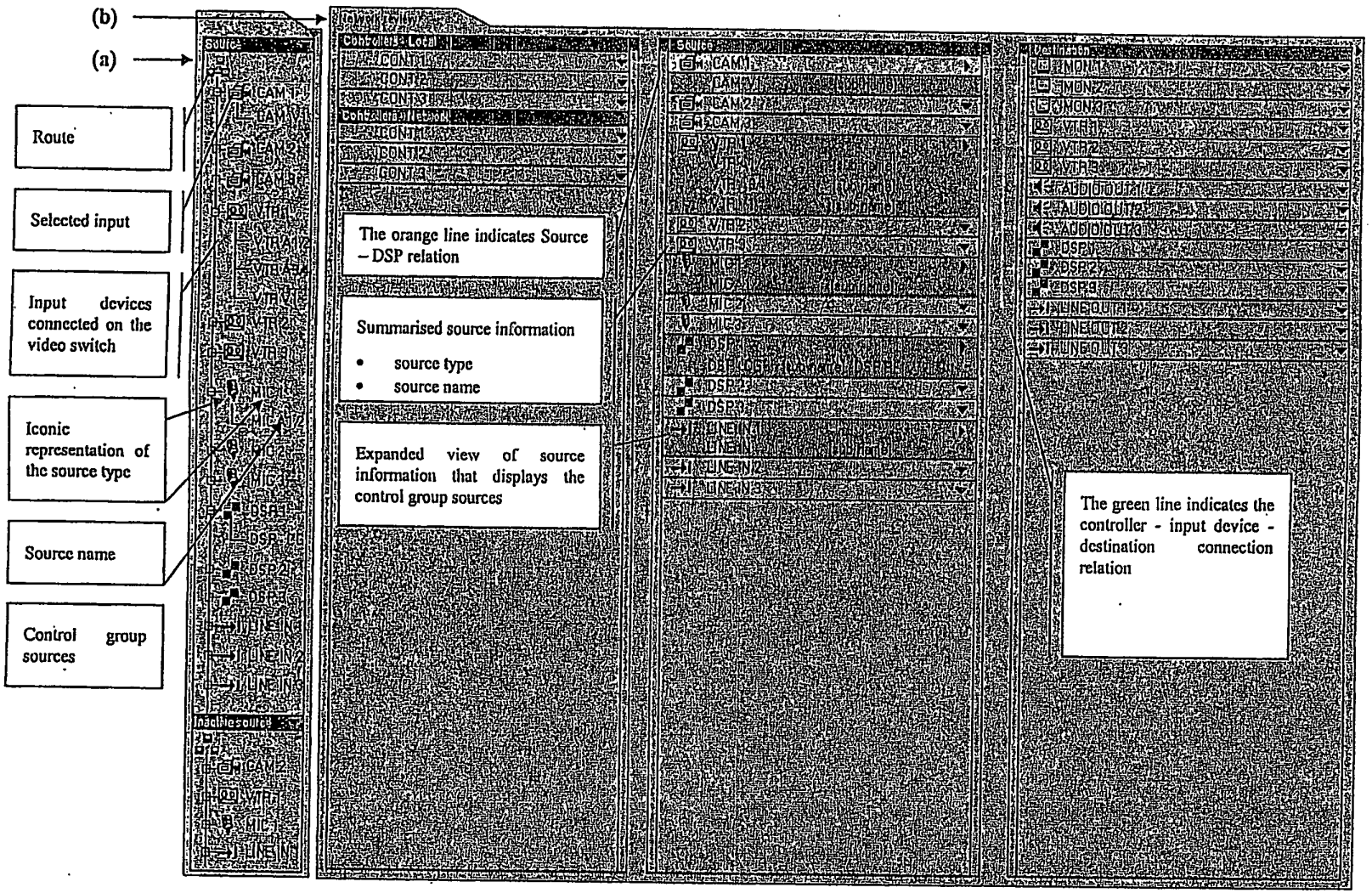


Figure 5 Network management area

3.1.1.2 Source content review area

The source content review area provides a means of reviewing the source content (in low or high resolution) and control the source (update or change source information and configuration).

The source content review area should:

- provide a means for reviewing source content in low resolution
- provide a means for reviewing source content in high resolution
- currently selected output of the video switch in high resolution
- provide an audio monitor to support the main audio channel, of any source
- display currently selected output of the video switch
- provide a way to create – modify a source pre-selection list
- provide a means of reviewing the source status
- provide a means for reviewing control group sources
- provide a means for reviewing source information
    - type of source
    - tally name
    - tally status: play / stop / pause
    - time-code
    - matrix
    - more destination information
- provide a means to configure source information (e.g. name)
- local control of the preview source which has to reflect the controls of the source selected (e.g. video, audio)
- provide a mechanism for assigning assign source to a controller
- relation between source and preview
- relation between source and destination

See Figure 6 bellow.

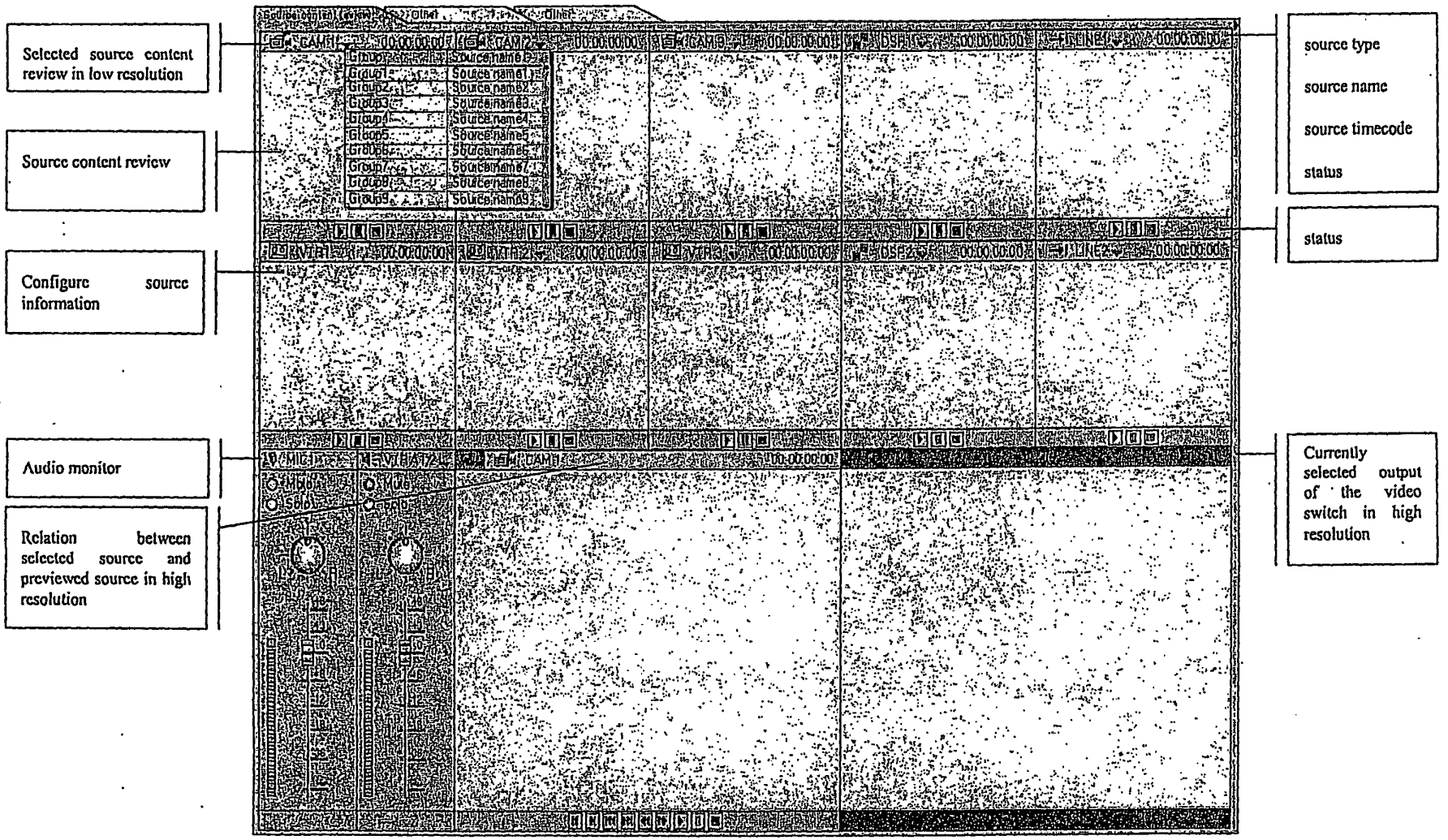


Figure 6 Source content review area

3.1.1.3 Routing review area

The routing review area provides detailed information about the actual routing of the devices connected to the network. Two views are provided:

- a minimised version of the routing review (see Figure 8a)

  This shows instantaneously the routing between the selected input device - to specific destinations. To make a connection, activate a source and a destination button and these will light up. This design solution is very similar to the one current control panels provide – a row if buttons that represent input devices and a row of buttons that represent output devices that are highlighted indicating the devices connectivity (see Figure 7).

- an expanded version of the routing review (see Figure 8b)

  - the routing between input devices' and destinations' control groups is provided

    To review a connection, activate a source control group button and the connected destination control group buttons will light up. The control group buttons are the smaller square button below the device button.

  - viewing each input/destination on control group level basis is provided

    By selecting a particular control group a user can limit all connections to that level.

  - a global review of the network routing is provided

    Each input device is represented with a different number (from left to right) and a colour (e.g. in Figure 7b the first device connected in the network (camera 1), is number 0 and represented with red colour). The destination window is a matrix with different colours in different rows, indicating the destination devices an input device is connected to. Each row in the destination window is numbered according to the numbers the input devices are numbered (from top to bottom). To represent the routing between input/destination devices each row is coloured with the same colour with the input device that brings the same number (e.g. row 0 is coloured red).

    Providing a global view of the network connectivity critically contributes into adding awareness of the network connectivity and make decisions of the devices can be assigned, or disconnected from the network and how this affects the network connectivity.

Figure 7 Typical video matrix switch panel

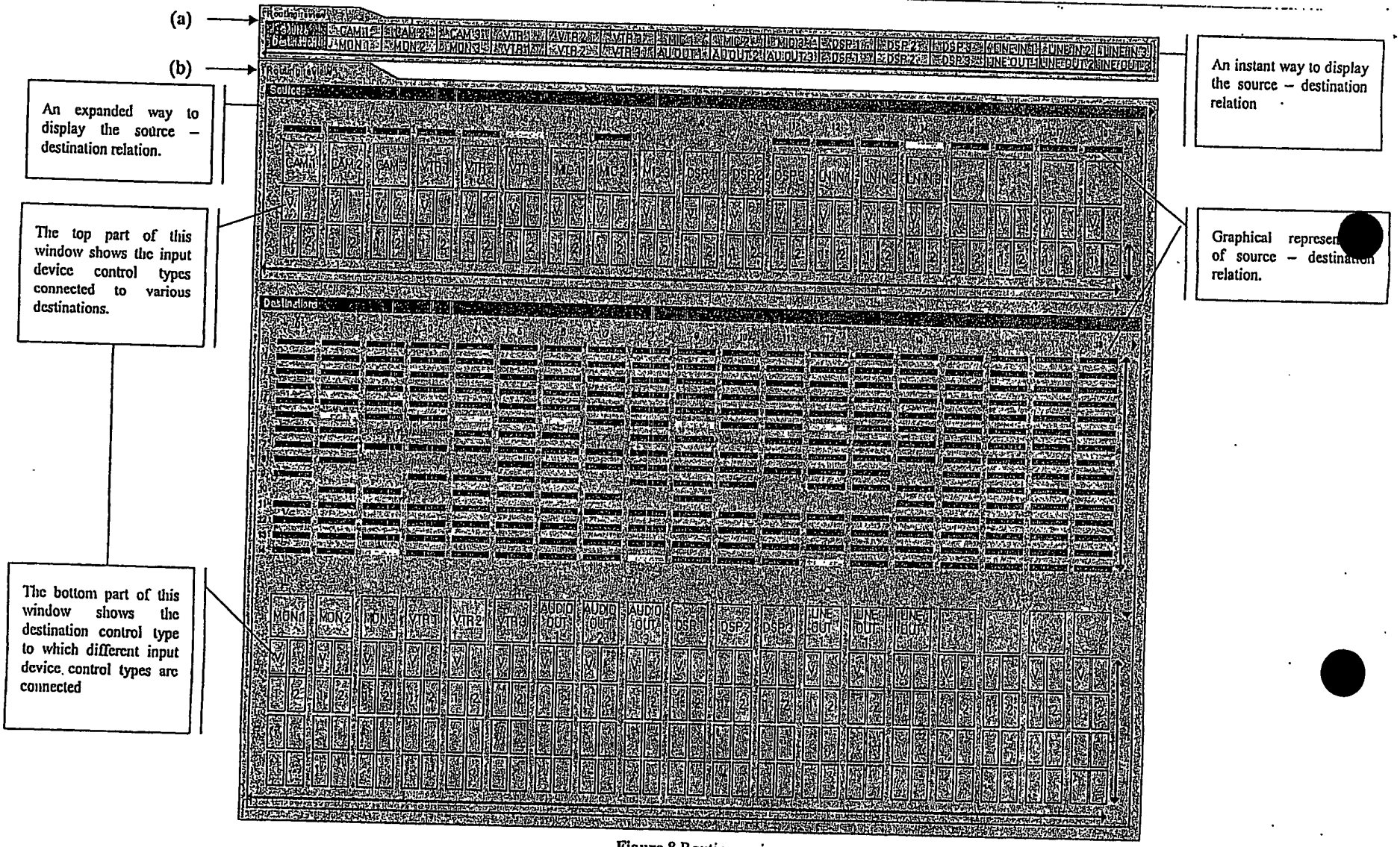


Figure 8 Routing review area

3.1.1.4 Trace routing

More information is required regarding what exactly needs to be represented in trace routing.

3.1.2 Review of current networking GUI design solutions

The design solutions to represent network routing and especially of providing a way to represent a global view of the network routing, have been based on engineers requirements, and a review of current design solutions to similar ideas. The following sections describe GUIs of popular video routers and matrixes, that show how current software address the network routing representation.

3.1.2.1 X-windows Interface for Remote Video Routing (XIRVR)

The Cornell Theory Center Visualization Group uses Grass Valley Group's Horizon Routing Systems for all of the analog equipment in it's VLAN. This router control panel allows for 32 by 32 routing on four signal levels to be done. To operate the router physical proximity to the control panel is necessary. The repeated need to perform a connection has created the demand for a remote video routing capability. X-windows Interface for Remote Video Routing, or simply XIRVR (pronounced "server") provide a multi-user distributed control panel for all routing functions. The graphical interface has three parts (see Figure 9):

- a top section with source buttons
- a middle section with a status window and miscellaneous buttons
- a bottom section with destination buttons

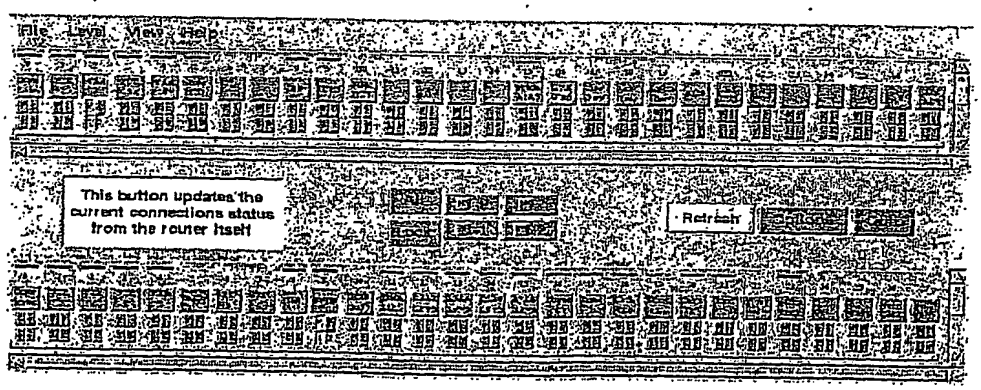


Figure 9 X-windows Interface for Remote Video Routing (XIRVR)

Source/Destination buttons

Each of these buttons has either a number or a brief description of the device. They are activated by pressing them. The rectangles under the buttons represent the connected

levels, depending on number of levels for router in use. In Figure 8, output 10 connected to input 8 on video level V and to input 5 on audio levels 1 and 2.

Middle part contains a device name display, level buttons, and other miscellaneous buttons.

The device name display shows the full name of the devices connected to the source or destination buttons that the mouse cursor is on top of. The level buttons are used to limit a connection to a particular level. The misc buttons include:

- refresh button to update the connections status from the router
- options button to bring up the options menu
- quit button to exit XIRVR

The XIRVR control panel was modelled after the Horizon HX-PXY control panel.

Options

The following options are available:

- button type - choose a button style
- show color bars - show or hide colour bars that differentiate between device types
- refresh gives the most recent and accurate connections status

3.1.2.2 Matrix Control Software and RS232 Control for Universal Matrix KVM Switches & Video Matrix Switches

Matrix Switcher's Control Program is included with the NTI switch. It supports Microsoft Windows® 95,98, NT4, ME & 2000.

The graphical software that supports the matrix provides fast control of up to 15 NTI switches, using an RS232 connection.

Automatically displays views for all attached NTI switches each time program is started.

View and control multiple switches simultaneously with three unique and powerful views:

- Matrix View
- Table View
- Line View

Its supports saving and loading: up to nine configurations from the switch's internal memory.

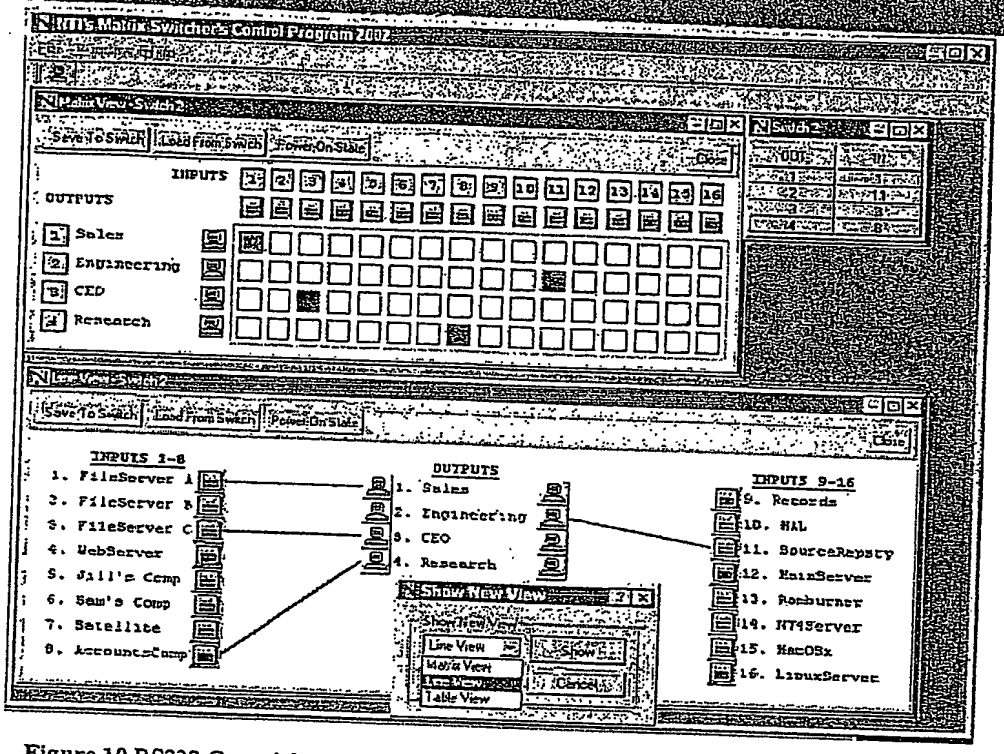


Figure 10 RS232 Control for Universal Matrix KVM Switches & Video Matrix Switches

3.1.2.3 RS232-Com GUI Control Software

The RS-232-COM is a router control software package for the Pro-video RS-1616 series routing switchers. The software runs under WINDOWS 95/98 utilising the serial RS-232 PC port. The RS-232-COM GUI enables the user to:

- view the entire matrix status
- control every cross-point
- mnemonic editor
- audio follow video or breakaway switching
- program up to 16 salvos
- change the configuration of the router to either one 16X16, two 8X8's or three 5X5
- change the configuration of the router for separate routers with assignable control panels

Any selections made via control panels are reflected and updated by the GUI and conversely any change done via the GUI are reflected to all control panels. The GUI software enables the router configuration to be changed, but also allows a number of independent router to exist within the one frame with separate control panels.

Figure 11, briefly explains the main functionality blocks of the RS-232-COM display screen.

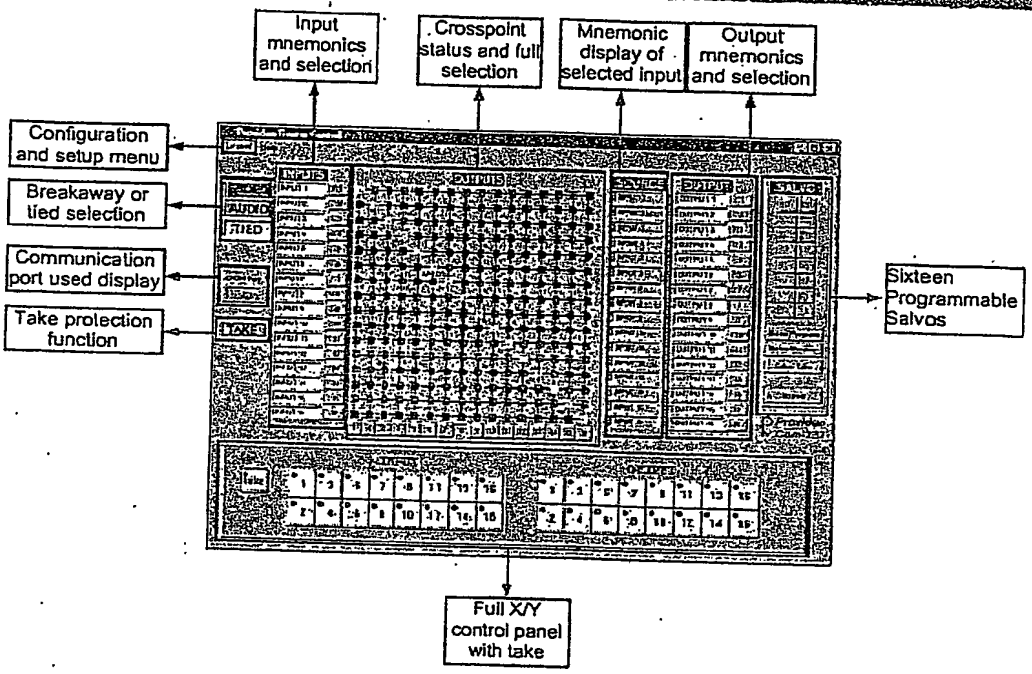


Figure 11 RS-232-COM display screen

3.1.2.4 BZR-2000

BZR-2000 is a setup program for the Sony Routing Switcher System.

With graphical indications, various settings necessary for operation of the system can be easily performed through user-friendly operations using a mouse.

BZR-2000 can be used with an IBM PC/AT-compatible computer on which Microsoft Windows 95, Windows 98,or Windows NT is installed.

BZR-2000 software allows the physical location of each device on the matrix to be set, and locate a device at any desired location on the matrix by dragging the icon of the device from the left window and dropping it onto the matrix. BZR-2000 software also allows displaying the status information on crosspoints at the specified level (see Figure 12).

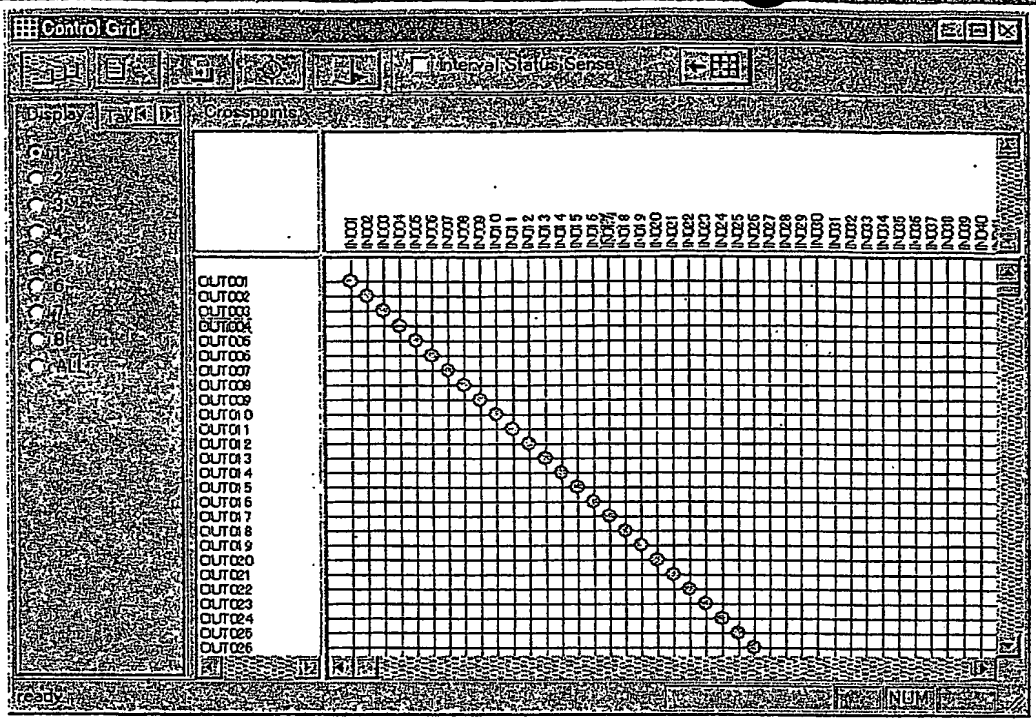


Figure 12 BZR-2000 software also allows displaying the status information on cross-points at the specified level

3.2 Video proxy pre-selection suite

The video proxy pre-selection suite provides a solution for video switching based on content review. The video proxy pre-selection suite functionality is provided by a single PC. This means that the video proxy pre-selection suite can be simultaneously available to different users providing different views and permissions according to different users' profile.

The GUI for the video proxy pre-selection suite is designed for a 1024x768 display (see Figure 13) and it is a touch screen.

The video proxy pre-selection GUI consists of the following components (see Figure 13):

- display currently assigned inputs to the live video switch, this is an iconic representation of the type of device

  This is provided by the network manager application.

- provide a means for reviewing source content in low resolution
- provide a mechanism for pre-selecting the sources to be reviewed

  This can be changed at any time.

- provide a means for reviewing source content in high resolution

- provide a mechanism for narrowing the source pre-selection to two for the final switching

- The switching from one source to another is instant and there is no delay

- provide an audio monitor to support the main audio channel for the sources reviewed in high resolution

- display currently selected output of the video switch (what is on air)

- provide a means of reviewing the source information (device, programme)

  This information is configured by the network manager application.

- provide a means to configure source information (e.g. name)

  The for addressing such a functionality is under enquiry.

- relation between source and preview

- relation between source and destination

- transition effects for switching are supported

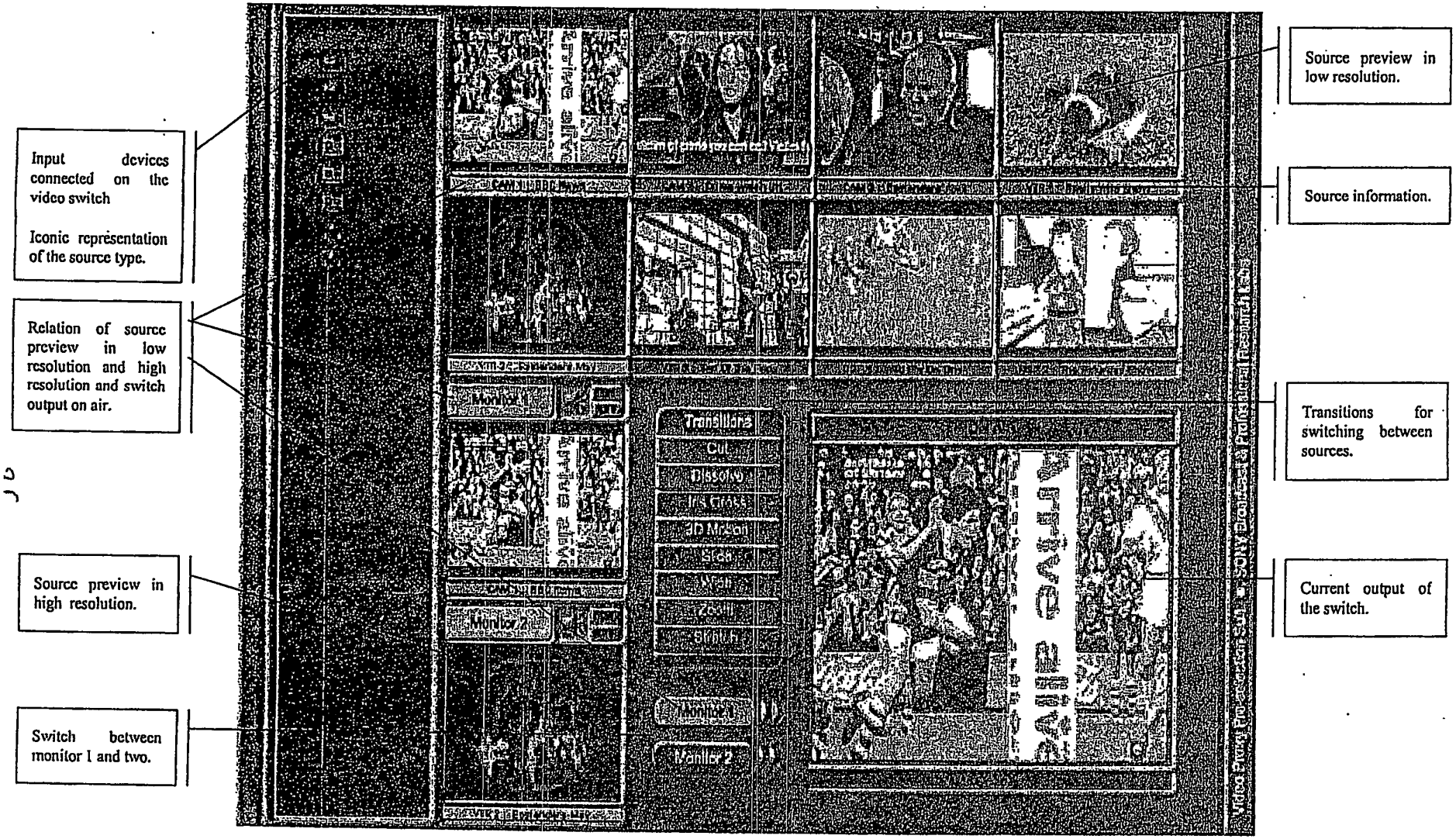


Figure 13 Video proxy pre-selection GUI

4 Introduction

An advantage of using IP networks to transport AV data, generated during the production process, is that it allows direct interface with other I.T. systems. Workstations, laptops and even handheld PDAs can be used as tools for AV switching, editing, collecting metadata, etc. A user normally wishes to make switching or editing decisions based on the content of video and/or audio. To support this processes it is proposed that a lower quality Video proxy of each stream is generated.

Several low bandwidth video formats exist that are streamed over RTP, but the majority of these are heavily compressed. Compression methods which introduce significant delay (> 1 field) would not be suitable for the applications proposed. Within the production environment it is expected that multiple sources will need to be displayed on a computer screen. It is uncertain whether a PC processor could decompress a large number of such sources without significant hardware acceleration. An uncompressed sub-sampled proxy video stream is therefore preferred.

The design of a proxy video format requires a delicate balance between perceived video quality and bandwidth consumption. The following table gives a subjective assessment of perceived video quality of some selected proxy video formats.

	Video format description	Data rate (Mbit/s)	Subjective quality
1	CIF (352X288), 24bit RGB, 12.5 frames/s, sub-sampling without filtering.	30.4	Unacceptable
2	CIF (352X288), 24bit RGB, 25 frames/s. sub-sampling without filtering.	60.8	Good
3	QCIF (176X144), 24bit RGB, 12.5 frames/s, sub-sampling without filtering.	7.6	Unacceptable+
4	QCIF (176X144), 24bit RGB, 12.5 frames/s, sub-sampling with horizontal filtering.	7.6	Unacceptable+
5	QCIF (176X144), 24bit RGB, 25 frames/s, sub-sampling without filtering.	15.2	Unacceptable+
6	QCIF (176X144), 24bit RGB, 25 frames/s, sub-sampling with horizontal filtering.	15.2	Acceptable-
7	QCIF (176X144), 24bit RGB, 25 frames/s, sub-sampling with both horizontal and vertical filtering.	15.2	Acceptable
8	QCIF (176X144), 16bit RGB, 25 frames/s, sub-sampling with both horizontal and vertical filtering.	10.0	Acceptable

From this table, it appears that while format 2 gives good visual quality, its data rate is completely unacceptable to be used as proxy video. Format 7 seems to strike the best balance between visual quality and data rate. The data rate of format 7 can be further reduced if 24bit RGB data can be reduced to a 16bit colour palette index or a R5G5B5 value. Initial research indicates that the 24bit RGB can be reduced to 16bit without perceivable degrading of visual quality.

In this embodiment, all audio and video data is to be sent over standard Gigabit Ethernet networks. The Proxy Video can be generated in real time by an AV enhanced network interface. This will ensure precise control of the timing of the Proxy Video frames with the

full bandwidth Video frames. The RTP protocol is the preferred protocol for sending real time video over such networks.
RTP does not currently have any profiles for the video formats identified above. An RTP profile will be created that includes source timecode data.

A full resolution RTP profile does exist however, which will initially form the basis for Proxy video RTP format. A document explaining our intended use of RTP for containing uncompressed and compressed video is fully explained in (Ref.1). It is possible that the MXF streaming protocol could also be used within RTP when storing completed sequences.

It is further proposed that the main uncompressed high-resolution stream and low-resolution stream could use multiple multicast streams to allow different quality levels.
The stream could use one multicast group for odd fields (or frames) and another for even fields (or frames). Only half the bandwidth would be required to receive just one of the multicasts. The full resolution signal would then be processed as a RGB CIF image at 25 frames per second and the Proxy video image as a RGB QCIF image at 12.5 frames per second. For the CIF images the receiving application could decide which proxy to receive to ensure the video data was well distributed between the two field (frame) periods.

The audio stream is only 6.1 $Mbit.s^{-1}$, so there is currently no requirement within the production LAN to provide a proxy version of audio.

The audio and multiple proxy video streams will be synchronised via the RTP timecode, based on a 27 MHz clock.

If the video sequences are only required to be viewed and not used interactively then they could be passed through a gateway application which could add some form of compression to the Audio and Proxy Video Streams. Additionally some form of access control would be applied.

5.

One example of the use of such Proxy Video concerns the use of Proxy video for PRESELECTION of video sources for a live video switch.

In a traditional SDI routing system nearly all sources are routed to a video switch to allow split second selection. Typically 32 to 64 inputs are made available.
It is proposed that it is not actually necessary to have so many inputs instantly available for selection at the video switch if another means is found for Pre-selection of the video sources. It is also suggested, that if the means for selection allows for instant access to greater information about the source before selection, that an improved workflow process would be achieved.

It is suggested that the lower resolution Proxy Video streams can be used for this purpose.

A PC display could display in a particular part of the screen the "Currently Assigned" Inputs to the live video switch as QCIF Proxy video streams. It seems that just six inputs may be sufficient in many cases. In another part of the screen most of the other sources, not currently assigned to the video switch, could be displayed as either QCIF streams or even QQCIF streams. Perhaps each group of these images would be contained in a logical grouping with some automatic selection of one of them to be shown as QCIF.

On another part of the screen the "Currently Selected Output" of the video switch could be displayed, either as QCIF or CIF or full resolution depending on the set-up of the receiving application.

Another area could be reserved for viewing a selected QCIF image as either a CIF image or full resolution image depending on the set-up of the receiving application.

A basic form of such a layout is shown in Fig 1.

As an operator, sitting in front of the screen, decides another input should be assigned to the video switch, it could be "dragged and dropped" onto one of the six "Currently Selected" streams thus causing them to be exchanged. Alternatively some other form of exchange selection could be used such as the use of dedicated hardware. The new stream would be available to be switched by the video switch and the previously assigned stream would reside in the "off line" section of the screen. To set up and breakdown such multicast links need only take about one second which should be suitable for the application suggested.

Before selection, as proposed above, any of the QCIF or QQCIF images could be dragged onto the "High resolution Preview Window" if it seems necessary to study the stream in more detail before selection.

Right clicking on any stream could allow other information about the scene to be displayed. Such information may be in a separate window or superimposed over the selected stream. It is thought that information such as; permissible camera movement, Currently used Zoom setting, Zoom range, name of cameraman, etc., would be of some value when setting up shots.

A separate application could be imagined where the pre-selection is for the purpose of setting up a DME move, the DME output being one of the inputs available for assignment to video Switch by the "Pre-selection Application".

It would be advantageous to have "Talk Back" available to the cameramen. If a cameraman wishes to contact the "Pre-selection Desk" an audio icon could be made to flash over the relevant proxy video stream.

Right clicking a stream and selecting "Audio Monitor" from a drop down menu could also monitor the main audio channel, of any source.

To enable the above functionality it is necessary to create an IP based live video streaming system with low latency

Underlying Technology

A Network interface produces the Proxy video stream from the high-resolution stream which is sent to the interface from some external source. The interface could form part of the source itself.

When the source is uncompressed video, (SDI), the proxy will be generated by first horizontally filtering the SDI image and then sub sampling to reduce the number of samples per line ie. from 720 to 180. Every other line of the first field is then sent to a separate Packetising function where the data is appended with the RTP /UDP/IP headers. The data is then sent out of the interface during both the first and second fields.

When the source data is from a compressed source such as Digital Betacam, HDCAM, or other professional format the DC or low-resolution part is extracted directly for use as the proxy video stream.

All video, audio and other data and control information are sent over the IP network. No other interconnection between the equipment is required.

To interconnect with existing SDI or STDI equipment a stand-alone Network interface would be developed with multiple SDI/SDTI in/out interfacing with one Gigabit Ethernet port. Naturally 10Gigabit or higher is also possible in the future.
A video switch might well use two or more of these standalone units to allow the required number of SDI inputs/outs to the Video Switch.

The Network Manager (as described in Multicast Patent) is responsible for assigning the multicast IP addresses to each stream generated on every network interface which makes up the system. The assignment occurs when each AV device is first powered up by referring to a database application running on the network manager using DHCP commands. All devices will be pre-registered with the network manager in advance to ensure correct population of the database.

The client application, as described above, would also link to the network manager.

When a "Drag and Drop" action is performed, using the GUI, or some other method, a command is sent form the client application to the Network manager to indicate that the "Video Switch" network interface wishes to receive the new Multicast group and to indicate to which output from the Video Switch interface the new stream should be extracted. It will also be told to which existing multicast stream it need no longer belong. The network manager would not allow an "on-air" stream to be removed from the Video Switch interface. It is expected the communication from the client to the Network manager will use the SNMP protocol but other protocols could also be used.

Communication from the Network manager to each participating Network Interface uses a propriety protocol named (Audio Video Switching Control Protocol). Using this protocol the Network manager would set-up the Video-Switch Network Interfaces as required.

Once the multicast groups are set up, as indicated, the A/V data is automatically received by the network interfaces connected to the Video Switch. The pre-selection process has been completed.

Naturally audio streams can be pre-selected in the same way.

Applications will also join the multicast groups of associated Proxy Video streams as required. The network manager will send data about all available proxy video streams to each client to enable pre-selection of the Proxy Video streams. These lists could be made available through an "open" menu option.

To cope with power loss situations the database will always store the latest configurations to allow immediate recovery. Each interface will contact the database directly during its power-up initialisation process. If the database fails each interface card will maintain its current configuration until the database application has recovered.

The "Gateway" function could recode selected Proxy streams using a suitable compression method such as MPEG-4.

Fig 1.

Basic form of GUI to control A/V pre-selection using Proxy video streams

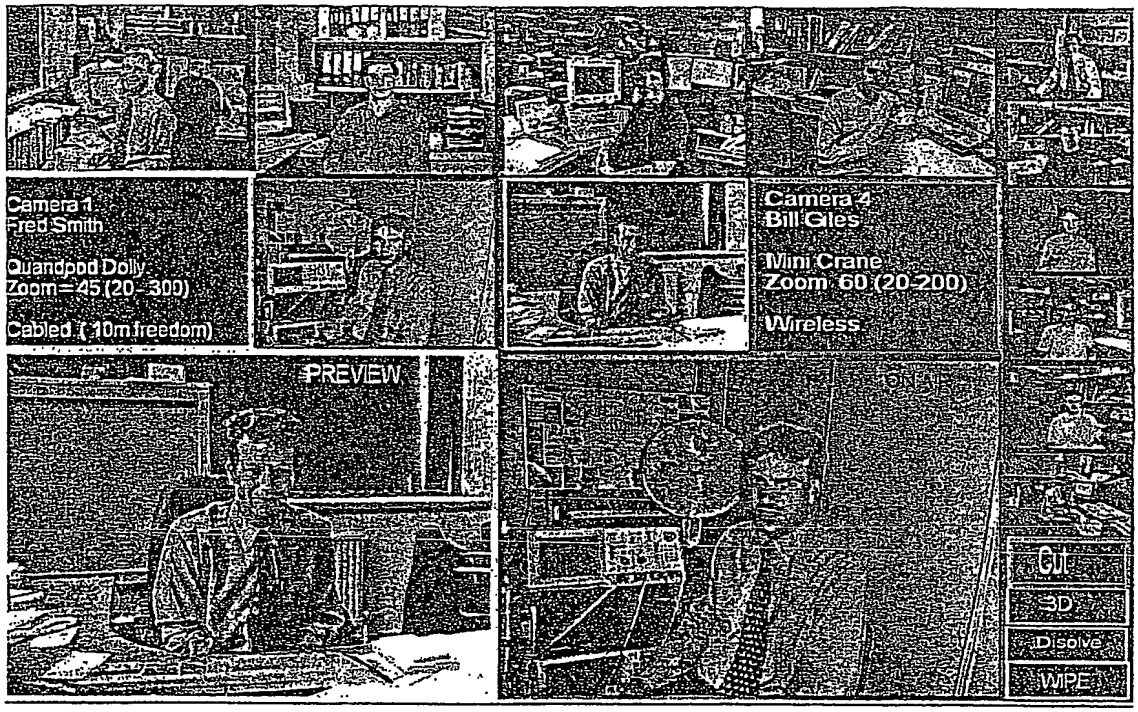


Fig 2.
Example of Networked A/V system using Proxy Video streams for Pre-selection of Video switch inputs.